(12) UK Patent Application (19) GB (11) 2 225 690 (13) A

(43) Date of A publication 06.06.1990

(21) Application No 8925995.6

(22) Date of filing 17.11.1989

(30) Priority data
(31) 3591 (32) 01.12.1988 (33) IE

(51) INT CL[5]
H04L 12/44, G06F 13/22

(52) UK CL (Edition K)
H4P PPJB

(56) Documents cited
GB 1298190 A EP 0175170 A2 WO 86/00733 A1

(58) Field of search
UK CL (Edition J) H4P PPG PPJB
INT CL[4] G06F, H04L

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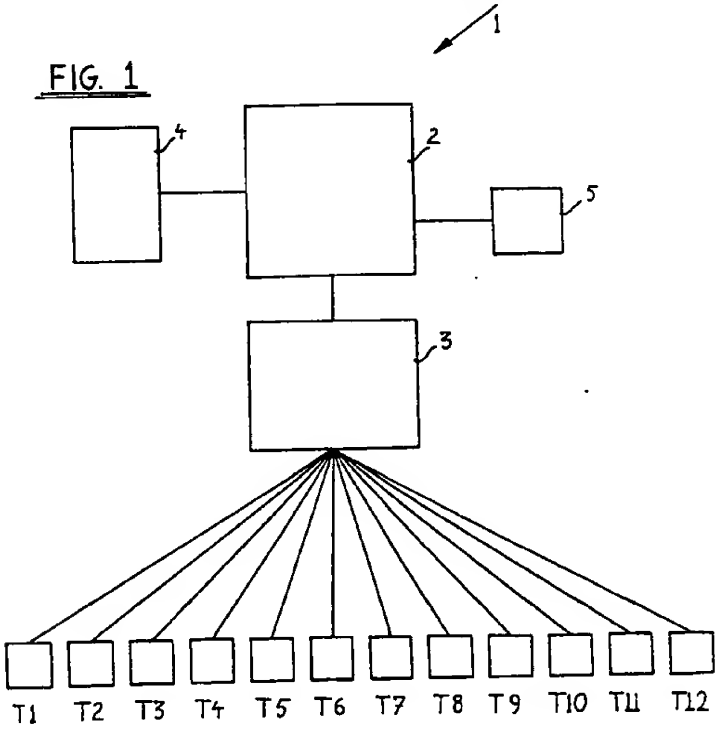
(54) Data handling apparatus

(57) Data handling apparatus comprises a host computer (2) which controls a network controller (3), and a network of terminals (T1) to (T12) under the control of the network controller (3). The network controller (3) transmits data from the terminals (T1) to (T12) to the host computer (2). The host computer (2) controls the polling sequence by which the network controller polls the terminals (T1) to (T12). On a terminal (T1) to (T12) going off-line, the host computer removes it from the polling sequence and stores the identity of the terminal for a predetermined time period. After the predetermined time period having timed out, the host computer (2) returns the off-line terminal into the polling sequence of the network controller (3). Should the off-line terminal be found still to be off-line it is removed for a greater predetermined time period.

FIG. 1



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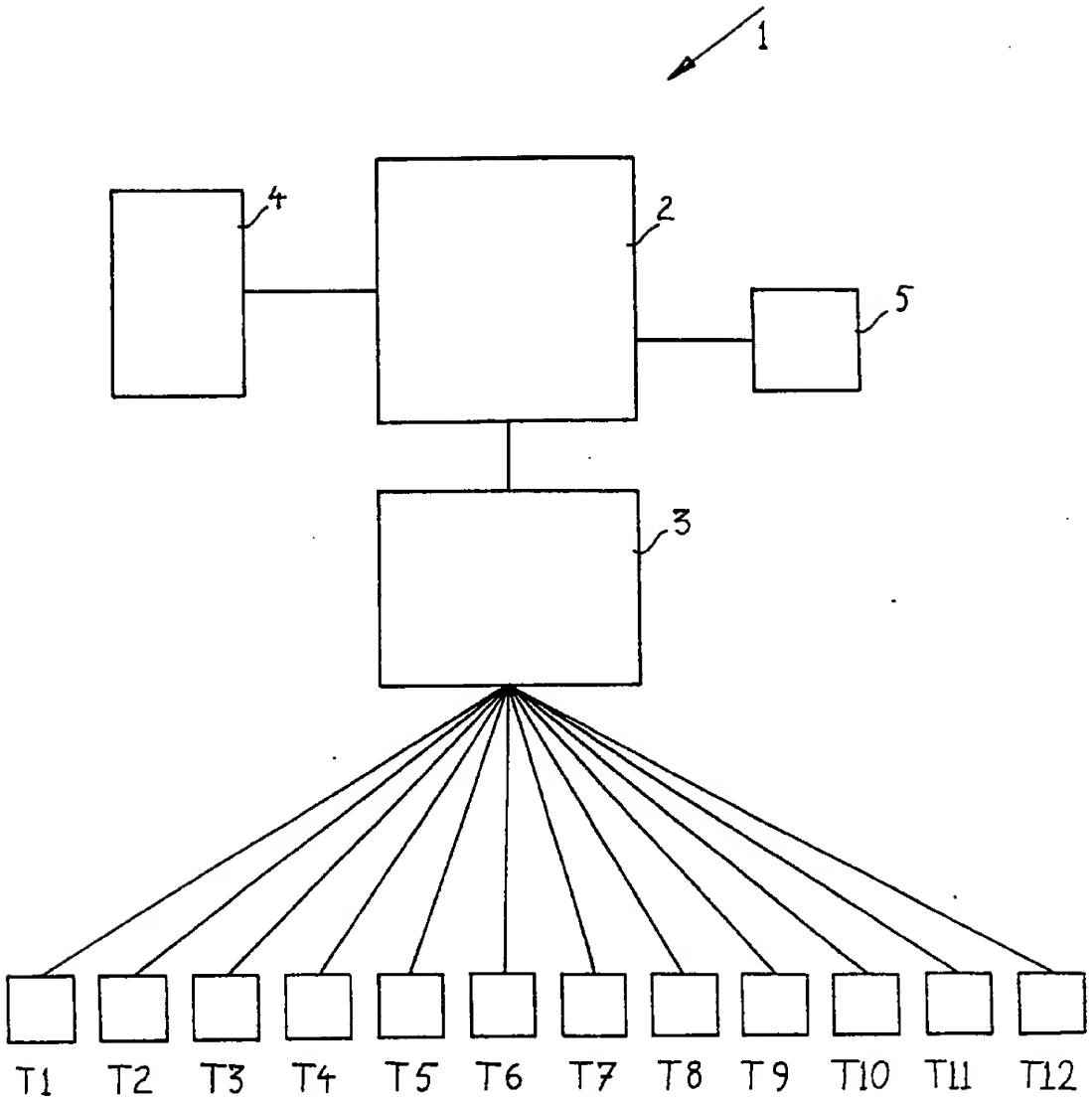

FIG. 1

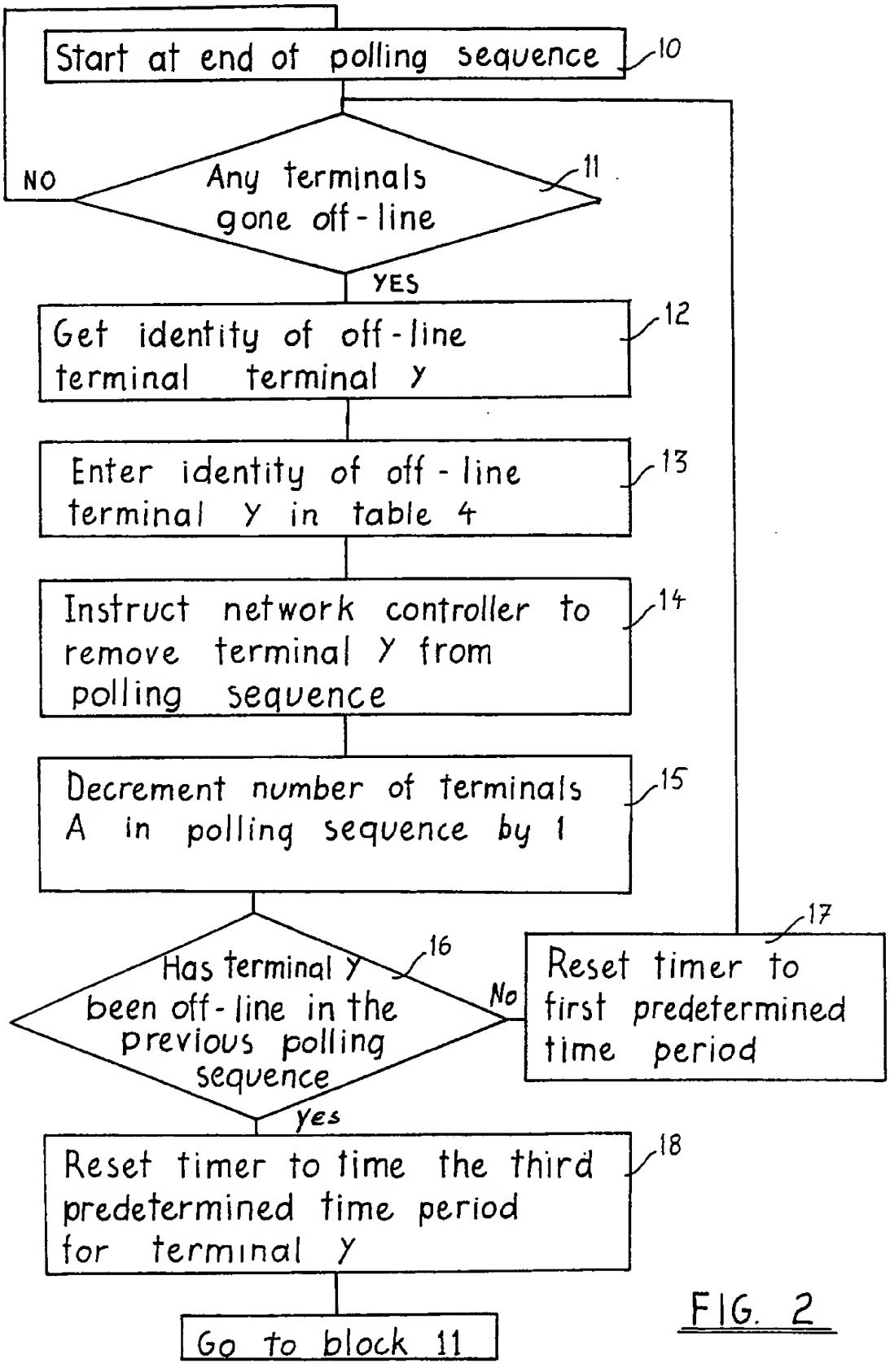
Start at end of polling sequence
10
Any terminals gone off-line
11
NO
YES
Get identity of off-line terminal terminal Y
12
Enter identity of off-line terminal Y in table 4
13
Instruct network controller to remove terminal Y from polling sequence
14
Decrement number of terminals A in polling sequence by 1
15
Has terminal Y been off-line in the previous polling sequence
16
No
yes
Reset timer to first predetermined time period
17
Reset timer to time the third predetermined time period for terminal Y
18
Go to block 11

FIG. 2

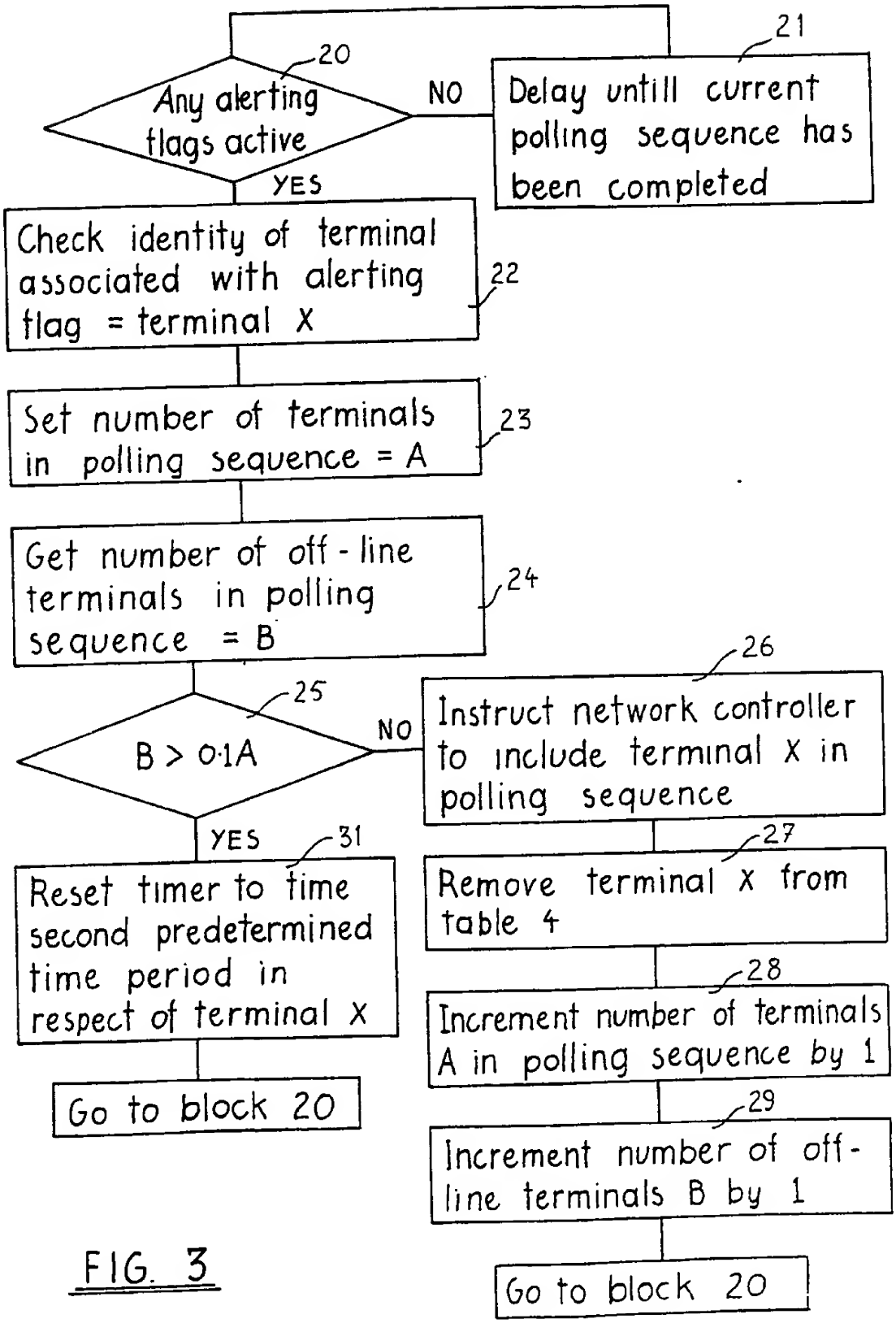
20
Any alerting flags active
NO
21
Delay untill current polling sequence has been completed
YES
Check identity of terminal associated with alerting flag = terminal X
22
Set number of terminals in polling sequence = A
23
Get number of off-line terminals in polling sequence = B
24
25
B > 0·1A
NO
26
Instruct network controller to include terminal X in polling sequence
YES
31
Reset timer to time second predetermined time period in respect of terminal X
Go to block 20
27
Remove terminal X from table 4
28
Increment number of terminals A in polling sequence by 1
29
Increment number of off-line terminals B by 1
Go to block 20

FIG. 3

DATA HANDLING APPARATUS

The present invention relates to data handling apparatus and also to a method for handling data in the apparatus.

According to the invention, there is provided data handling apparatus comprising:

a host computer to control the apparatus,

a plurality of terminals for inputting and/or outputting data,

a network controller to control the terminals under the control of the host computer and to transmit data between the terminals and the host computer, the terminals being networked to the network controller,

the network controller comprising

a polling means to poll at least some of the terminals sequentially in a polling sequence under the control of the host computer,

means to detect an off-line terminal and communicate details of the off-line terminal to the host computer,

the host computer comprising:

storing means for storing a list of identities of the off-line terminals,

timing means for timing a first predetermined time period for respective off-line terminals,

start means to start the timing means timing the first predetermined time period for each off-line

terminal on or after the terminal going off-line,

alerting means responsive to the timing means timing out in respect of an off-line terminal,

instructing means to instruct the network controller to remove an off-line terminal from the polling sequence, and to instruct the network controller to include an off-line terminal in the polling sequence in response to the alerting means being activated in respect of that off-line terminal.

Preferably, the host computer comprises counting means for counting the number of off-line terminals in the polling sequence, and means for preventing the instruction means instructing the network controller to poll more than a maximum predetermined number of off-line terminals during each polling sequence.

In one embodiment of the invention, means for resetting the timing means is provided in the host computer for timing a second predetermined time period for an off-line terminal should a first predetermined time period time out and the number of off-line terminals in the polling sequence exceeds the maximum predetermined number.

In another embodiment of the invention, the host computer comprises means to reset the timing means for

a third predetermined time period in respect of an off-line terminal having been in the off-line terminal storing means during the previous polling sequence.

The invention also provides a method for handling data in data handling apparatus which comprises a host computer, a plurality of terminals for inputting and/or outputting data and a network controller to control the terminal under the control of the host computer, the method comprising the steps of polling at least some of the terminals in a polling sequence by the network controller under the control of the host computer, detecting an off-line terminal and communicating details of the off-line terminal from the network controller to the host computer, storing the identity of the off-line terminal in storing means in the host computer, setting a timing means in the host computer for timing a first predetermined time period for the off-line terminal on or after the off-line terminal has gone off-line, activating an alerting means in the host computer in response to the timing means timing out in respect of an off-line terminal, issuing an instruction from the host computer to instruct the network controller to remove an off-line terminal from the polling sequence, and issuing an instruction from the host computer to the network controller to include an off-line terminal in

the polling sequence, in response to the alerting means being activated in respect of that off-line terminal.

Preferably, the method includes the further steps of counting the number of off-line terminals being polled in the polling sequence, comparing the number of off-line terminals being polled with the total number of terminals being polled, and preventing the instructing means instructing the network controller to poll an off-line terminal should the off-line terminals in the polling sequence exceed a maximum predetermined number.

In one embodiment of the invention, the method includes the step of resetting the timing means for timing a second predetermined time period should a first predetermined time period time out and the number of off-line terminals in a polling sequence exceeds the maximum predetermined number.

Advantageously, the method includes the step of resetting the timing means for a third predetermined time period in respect of an off-line terminal having been in the off-line terminal storing means during the previous polling sequence.

The invention will be more clearly understood from the following description of a preferred embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of data handling apparatus according to the invention,

Fig. 2 is a flow chart of a sub-routine for use in the data handling apparatus of Fig. 1, and

Fig. 3 is a flow chart of another sub-routine for use in the data handling apparatus of Fig. 1.

Referring to the drawings, and initially to Fig. 1, there is illustrated data handling apparatus according to the invention indicated generally by the reference numeral 1. The apparatus 1 comprises a host computer 2 and a network controller 3, which operates under the control of the host computer 2. A plurality of terminals, in this case twelve terminals namely T1 to T12 are connected in a network to the network controller 3 which polls the terminals T1 to T12 under the control of the host computer 2 and also supervises dialog with the operator of each terminal T1 to T12. The host computer may be any type of computer, namely a main frame computer, a personal computer or the

like. The network controller is a BURR-BROWN TM900 Transaction processor. The terminals T1 to T12 may be of any type, for example, they may be keyboards, BAR code reading wands, voice recognition units, or any other suitable data input or output terminal, or any combination of some or all of these. They may also comprise visual display screens for visually displaying the data being entered and/or transmitted from the network controller 3 to the appropriate terminal. The terminals T1 to T12 are polled by the network controller 3 in a polling sequence which is determined by the network controller 3 and which is described below. As each terminal T1 to T12 is polled, data is transmitted between the terminal polled and the network controller 3 and vice versa. Data received in the network controller 3 from the terminal is stored for transmission to the host computer 2. Some of the data received by the network controller 3, which would be of a housekeeping nature, is handled by the network controller. The remaining data is transmitted by the network controller 3 to the host computer 2. This data is transmitted using standard transmission techniques which will be well known to those skilled in the art.

Initially, under the control of the host computer all terminals are initiallised and polled by the network

controller in the sequence T1, T2 .... T12, needless to say, any other polling sequence may be used. As each polling sequence is completed by the polling of the last terminal in the sequence, the network controller returns to the first terminal in the polling sequence and commences to poll the terminals in accordance with the polling sequence. On a terminal T1 to T12 going off-line the terminal is identified by the network controller 3 and recorded. The identity of the off-line terminal T1 to T12 is transmitted to the host computer 2 which instructs the network controller 3 to remove the off-line terminal from its polling sequence. The host computer 2 stores the identity of the off-line terminal in a storing means, in this case a table 4 provided by temporary registers in the host computer 2. A timing means which in this case is provided by a clock timer 5 of the host computer is activated on the identity of the off-line terminal being entered in the table 4. The timer times a predetermined time period, in this case a first predetermined time period of 15 seconds. The off-line terminal remains unpolled by the network controller 3 during the first predetermined time period. When the timer has timed out after the first predetermined time period, an alerting means, namely a flag indicates to the host computer that the timer has timed out in respect of that off-line terminal. The

host computer 2 then instructs the network controller 3 to include the off-line terminal in the polling sequence, and it is polled again. By removing the off-line terminal from the polling sequence for 15 seconds time wastage is avoided by virtue of the fact that the network controller 3 does not waste time polling a terminal which is off-line. Should the off-line terminal be found to be back on-line when polled, it remains in the polling sequence. If the off-line terminal is still off-line when polled, this information is transmitted to the host computer 2 by the network controller 3 which again removes the off-line terminal from the polling sequence for a further predetermined time period, in this case, a third predetermined time period of 30 seconds. After the timer has timed the third predetermined time period, the off-line terminal is again included in the polling sequence of the network controller 3.

Fig. 2 illustrates a flow chart of a sub-routine of a computer programme in the host computer which checks for off-line terminals. Block 10 of the flow chart commences the sub-routine at the end of a polling sequence of the network controller 3. Block 11 checks with the network controller 3 if any terminals have been found to be off-line in the polling sequence just completed. If no terminals have been found to be

off-line, the programmes returns to block 10. If one or more terminals have been found to be off-line, the programme moves to block 12, which gets the identity of the off-line terminal, for convenience, an off-line terminal is referred to as terminal Y. Block 13 enters the identity of the off-line terminal Y in the table 4. Block 14 instructs the network controller 3 to remove the off-line terminal terminal Y from the polling sequence. A count "A" is kept in the host computer of the terminals T1 to T12 which are being polled by the network controller 3 in the polling sequence. Block 15 reduces the count A by 1. Block 16 checks if the off-line terminal Y was in the table 4 during the previous polling sequence, or if it has just gone off-line. If the terminal Y has just gone off-line, the programme moves to block 17. Block 17 sets the clock timer 5 to time the first predetermined time period and the programme returns to block 11 to check if there are any more off-line terminals Y from that polling sequence. If block 16 determines that the terminal Y had been in the table 4 during the previous polling sequence, the programme moves to block 18. Block 18 resets the timer to time the third predetermined time period for the terminal Y. The programme then returns to block 11.

Fig. 3 illustrates a flow chart of a sub-routine of

the computer programme in the host computer which returns an off-line terminal Y into the polling sequence of the network controller 3. Block 20 of the sub-routine checks if any of the alerting flags have been activated in response to the timer timing out in respect of any of the off-line terminals in the table 4. If no flags have been activated the sub-routine moves to block 21 which is a time delay. Block 20 delays the sub-routine for a time period similar to the time period of a polling sequence. The sub-routine then returns to block 20. On block 20 detecting an activated alerting flag, the sub-routine moves to block 22 which checks the identity of the off-line terminal associated with the alerting flag which in this case for convenience is referred to as off-line terminal X. Block 23 gets the number of terminals being polled from the count A in the host computer. Block 24 gets the number of off-line terminals which have been reintroduced to the polling sequence, which is obtained from a count described below in the host computer and referred to as the value B. Block 25 checks if the value of B is greater than one tenth of the value A. In other words, does the number of off-line terminals being polled exceed a maximum predetermined number which in this case is one tenth of the number of terminals being polled. If the number of off-line terminals being polled does not

exceed one tenth of the number of terminals being polled, the sub-routine moves to block 26. Block 26 instructs the network controller to include the off-line terminal X in the next polling sequence. Block 27 then removes the off-line terminal X from the table 4. Block 28 increments the count B of the number of terminals being polled by 1. Block 29 increments the number of off-line terminals being polled by 1. This is the count which was referred to when discussing block 24. Accordingly, as each off-line terminal is returned to a polling sequence, it is counted as an off-line terminal for that polling sequence for which it is reintroduced. This avoids the number of returned off-line terminals X in the polling sequence exceeding ten percent of the terminals being polled. The sub-routine then returns to block 20.

In the event that the value of B is greater than ten percent of the value of A, in other words, if more than ten percent of the terminals in the polling sequence are returned off-line terminals, then the terminal X is not included in the polling sequence. The sub-routine moves to block 31, which resets the timer in respect of the terminal X to a second predetermined time period, which in this case is 3 seconds. Accordingly, the terminal X is then picked

up by block 20 on the timer having timed out the second predetermined time period of 3 seconds and entered in the polling sequence of the network controller 3. The sub-routine then moves to block 20.

On being polled, each terminal T1 to T12 if it is on-line transmits any data it has available to the network controller 3. Similarly, if the network controller has data for transmission to the appropriate terminal, this data is also transmitted. The data received on each polling sequence by the network controller 3 from the terminals T1 to T12 is analysed and stored. The data which relates to housekeeping between the network controller and the terminals T1 to T12 is dealt with by the network controller 3.

The advantages of the invention are many. A particularly important advantage of the invention is the fact that number of off-line terminals being polled in any sequence can be restricted. This accordingly prevents considerable time wasting and speeds up each polling sequence. In other words, terminals which are known to be off-line are not polled. It has been found that, in general, it takes three to five times the time period to poll an off-line terminal than to poll an on-line terminal.

Thus, by removing off-line terminals for a predetermined time period, the time cycle for each polling sequence is considerably reduced. After an appropriate predermined time period, when the off-line terminal would have had the opportunity of going back on-line, it is again polled and checked. Needless to say, it will be appreciated by those skilled in the art that where a terminal is found to be off-line, appropriate indications of this are given by the host computer, network controller and in certain cases the fact that a terminal is found by the network controller to be off-line may be displayed on the visual display of the host computer. This thus permits appropriate action to be taken.

While the apparatus has been described as comprising a particular type of network controller, any other suitable network controller could be used. For example, a BURR-BROWN TM9000 Transaction processor may be used. It will also of course be appreciated that while the apparatus has been described as comprising twelve terminals, any number of terminals could be provided, more or less as desired. It will also of course be appreciated that any types of terminals could be used besides those described. Indeed, in certain cases, as well as the network controller controlling terminals, it could also control

programmable logic controllers. It is also envisaged that the host computer may control a number of network controllers each controlling a number of terminals. While specific predetermined time periods have been described during which an off-line terminal is removed from the polling sequence, off-line terminals could be removed from the polling sequence for any other desired periods of time. In fact, in general, it has been found that an off-line terminal may be removed for any time period within practical limits, however, in general, it is believed that it is unlikely that an off-line terminal would be removed for less than 5 seconds or more than 60 seconds. In general, it has been found that best results are achieved by removing the off-line terminal from the polling sequence for a time period which is equivalent to between sixty polling sequences and one hundred polling sequences, although this would depend on the particular network. Needless to say, it is preferable to keep as many off-line terminals out of the polling sequence as possible. Where an off-line terminal is removed for second and subsequent periods as a result of not having come on-line, the third predetermined time periods may be extended on each occasion, or may be the same and in certain cases after the off-line terminal being removed after a certain number of time periods, the off-line terminal may be removed

permanently until outside action was taken to deal with the terminal.

It will also be appreciated that while the number of off-line terminals reintroduced into a polling sequence has been retained at not more than 10% of the terminals being polled, in certain cases it is envisaged that the limit of off-line terminals being polled could be greater or lesser than 10% of all terminals being polled. Indeed, in certain cases, it is envisaged that off-line terminals may account for up to 50% of terminals being polled. However, this will largely depend on the number of terminals in the network.

CLAIMS

1. Data handling apparatus comprising:

a host computer to control the apparatus,

a plurality of terminals for inputting and/or outputting data,

a network controller to control the terminals under the control of the host computer and to transmit data between the terminals and the host computer, the terminals being networked to the network controller,

the network controller comprising

a polling means to poll at least some of the terminals sequentially in a polling sequence under the control of the host computer,

means to detect an off-line terminal and communicate details of the off-line terminal to the host computer,

the host computer comprising:

storing means for storing a list of identities of the off-line terminals,

timing means for timing a first predetermined time period for respective off-line terminals,

start means to start the timing means timing the first predetermined time period for each off-line terminal on or after the terminal going off-line,

alerting means responsive to the timing means timing out in respect of an off-line terminal,

instructing means to instruct the network controller to remove an off-line terminal from the polling sequence, and to instruct the network controller to include an off-line terminal in the polling sequence in response to the alerting means being activated in respect of that off-line terminal.

2. Data handling apparatus as claimed in Claim 1 in which the host computer comprises counting means for counting the number of off-line terminals in the polling sequence, and means for preventing the instruction means instructing the network controller to poll more than a maximum predetermined number of off-line terminals during each polling sequence.

3. Data handling apparatus as claimed in Claim 2 in which the maximum predetermined number of off-line terminals which may be polled during a polling sequence is not greater than fifty percent of the number of terminals being polled.

4. Data handling apparatus as claimed in Claim 3 in which the maximum predetermined number of off-line terminals is not greater than thirty percent of the number of terminals being polled.

5. Data handling apparatus as claimed in any of

Claims 2 to 4 in which means for resetting the timing means is provided in the host computer for timing a second predetermined time period for an off-line terminal should a first predetermined time period time out and the number of off-line terminals in the polling sequence exceeds the maximum predetermined number.

6. Data handling apparatus as claimed in Claim 5 in which the second predetermined time period is in the range of 1 to 5 seconds.

7. Data handling apparatus as claimed in Claim 6 in which the second predetermined time period is 3 seconds.

8. Data handling apparatus as claimed in any preceding claim in which the host computer comprises means to reset the timing means for a third predetermined time period in respect of an off-line terminal having been in the off-line terminal storing means during the previous polling sequence.

9. Data handling apparatus as claimed in Claim 8 in which the third predetermined time period is in the range of 15 to 60 seconds.

10. Data handling apparatus as claimed in Claim 9 in which the third predetermined time period is in the range of 20 to 40 seconds.

11. Data handling apparatus as claimed in Claim 10 in which the third predetermined time period is 30 seconds.

12. Data handling apparatus as claimed in any preceding claim in which the first predetermined time period is in the range of 10 to 60 seconds.

13. Data handling apparatus as claimed in Claim 12 in which the first predetermined time period is in the range of 12 to 40 seconds.

14. Data handling apparatus as claimed in Claim 13 in which the first predetermined time period is 15 seconds.

15. Data handling apparatus as claimed in any preceding claim in which the storing means is provided by a plurality of temporary storage registers in the host computer.

16. Data handling apparatus as claimed in any preceding claim in which the timing means comprises a

count down timer, one timing means being provided for each storing location.

17. Data handling apparatus substantially as described herein with reference to and as illustrated in the accompanying drawings.

18. A method for handling data in data handling apparatus which comprises a host computer, a plurality of terminals for inputting and/or outputting data and a network controller to control the terminal under the control of the host computer, the method comprising the steps of polling at least some of the terminals in a polling sequence by the network controller under the control of the host computer, detecting an off-line terminal and communicating details of the off-line terminal from the network controller to the host computer, storing the identity of the off-line terminal in storing means in the host computer, setting a timing means in the host computer for timing a first predetermined time period for the off-line terminal on or after the off-line terminal has gone off-line, activating an alerting means in the host computer in response to the timing means timing out in respect of an off-line terminal, issuing an instruction from the host computer to instruct the network controller to remove an off-line terminal from

the polling sequence, and issuing an instruction from the host computer to the network controller to include an off-line terminal in the polling sequence, in response to the alerting means being activated in respect of that off-line terminal.

19. A method as claimed in Claim 18 in which the method includes the further steps of counting the number of off-line terminals being polled in the polling sequence, comparing the number of off-line terminals being polled with the total number of terminals being polled, and preventing the instructing means instructing the network controller to poll an off-line terminal should the off-line terminals in the polling sequence exceed a maximum predetermined number.

20. A method as claimed in Claim 19 in which the maximum predetermined number of off-line terminals which may be polled during the polling sequence is not greater than 50% of the number of the terminals being polled.

21. A method as claimed in Claim 20 in which the maximum predetermined number of off-line terminals is not greater than 30% of the number of terminals being polled.

22. A method as claimed in Claim 20 or 21 in which the method includes the step of resetting the timing means for timing a second predetermined time period should a first predetermined time period time out and the number of off-line terminals in a polling sequence exceeds the maximum predetermined number.

23. A method as claimed in Claim 22 in which the second predetermined time period is in the range of 1 to 5 seconds.

24. A method as claimed in Claim 23 in which the second predetermined time period is 3 seconds.

25. A method as claimed in any of Claims 19 to 24 in which the method includes the step of resetting the timing means for a third predetermined time period in respect of an off-line terminal having been in the off-line terminal storing means during the previous polling sequence.

26. A method as claimed in Claim 25 in which the third predetermined time period is a period in the range of 15 to 60 seconds.

27. A method as claimed in Claim 26 in which the

third predetermined time period is a period in the range of 20 to 40 seconds.

28. A method as claimed in Claim 27 in which the third predetermined time period is 30 seconds.

29. A method as claimed in any of Claims 18 to 28 in which the first predetermined time period is in the range of 10 to 60 seconds.

30. A method as claimed in Claim 29 in which the first predetermined time period is in the range of 12 to 40 seconds.

31. A method as claimed in Claim 30 in which the first predetermined time period is 15 seconds.

32. A method for handling data in a data handling apparatus the method being substantially as described herein with reference to and as illustrated in the accompanying drawings.

33. A computer programme comprising the method of any of Claims 18 to 32.

34. A medium containing the computer programme of Claim 33.

35. A medium as claimed in Claim 34 in which the medium is a magnetic tape, a floppy disc, a hard disc, an optical disc or a read only memory of a computer.

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